REMARKS/ARGUMENTS

Claims 1 to 39 are now pending in this application. Claims 26 to 28 have been withdrawn from consideration. Claims 1, 5, 6, 7, 9, 13, 20, and 22 to 25 have been amended to clarify the present invention and to correct minor informalities. New claims 29 to 39 have been added.

Claims 1 to 12, 19, and 21 were rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. The Action sets forth that information describing the JISA hardness index is not set forth in the specification in a manner enabling the skilled artisan to practice the invention as claimed. Furthermore, the Action notes that information essential to practicing the claimed invention can be incorporated only by reference to issued United States patents. The Action argues that essential material incorporated by reference to non-Unites States patents fails to meet these criteria

established under § 112, first paragraph, as failing to adequately teach how to make and/or use the invention, and thereby failing to provide an enabling disclosure.

Applicants submit that the Japanese Industrial Standard (JIS) is a well-known testing methods standard. In this regard, Applicants will refer the Examiner to the Internet web site for the Japanese Industrial Standards Association (http://www.jsa.or.jp/default_english.asp). This web site links to an index of the standards, including "Hardness testing methods for rubber, vulcanized or thermoplastic", JIS K 6253, which is identified in the specification. An English language copy of JIS K 6253 is also being submitted as an attachment to this response (marked as "Attachment 1"). The test method is a standard, internationally recognized test method readily available in English and other languages, and is no different than identification of an ASTM or other well known test method.

Applicants also submit that this material is not impermissible "essential material incorporated by reference to non-United States Patents", as stated in the Office Action. The JISA hardness index is not incorporated by

reference. Rather, it is presented in the application as a well-known standard, and known to one skilled in the relevant art.

Furthermore, pursuant to MPEP § 2164.04 and relevant case law (see e.g. *In re Wright*, 999 F.2d 1557, 1562, 27 USPQ2d 1510, 1513 (Fed. Cir. 1993)), in order to make a rejection, the Examiner has the initial burden to establish a reasonable basis to question the enablement provided for the claimed invention. Pursuant to this authority, the Examiner must provide a reasonable explanation as to why the scope of protection provided by a claim is not adequately enabled by the disclosure. As stated by the court in *In re Marzocchi*, 439 F.2d 220, 224, 169 USPQ 367, 370 (CCPA 1971), it is incumbent upon the U.S. Patent and Trademark Office, whenever a rejection on this basis is made, to explain why it doubts the truth or accuracy of any statement in a supporting disclosure and to back up assertions of its own with acceptable evidence or reasoning which is inconsistent with the contested statement. Applicants respectfully submit that, for the reasons set forth above, the Action has not met this burden.

The Action has rejected claims 1 to 25 under 35 U.S.C. § 103 as being unpatentable over Dobkowski et al. (U.S. Patent No. 6,074,672) and Anderson (European Patent Application No. 01106007.6/Publication No. EP 1 136 064 A2), in view of Yoshimasa et al. (JP 11-216836/Publication No. 2000-103717).

The Action sets forth that Dobkowski et al. and Anderson teach the claimed silicone elastomer, colorant, and nylon fillers as old and well known in combination with various pharmaceutical carriers and excipients in a dosage form. The Action further states that these ingredients are taught as useful for formulating cosmetic formulations and various skin coverings. The Action does concede that claims 1 to 25, and the primary references differ as to the concomitant employment of these medicaments, and the specific hardness of the formulations. With regard to the first concession, the Action sets forth that the instant claims define nothing more than the concomitant use of conventional cosmetic agents, and that therefore, the recited claims define prima facie obvious subject matter. Furthermore, with regard to the specific hardness defined in the claims, the Action sets forth that Yoshimasa et al.

employs the recited compounds for the claimed cosmetic use, at a hardness encompassed by the instant claims. The Action does state that absent specific compression steps, not recited in the instant composition claims, the skilled artisan would expect on normal compression, the cited reference compounds to provide the hardness recited, absent information to the contrary.

The claims of the present application have been amended to more clearly recite the novel aspects of the present invention. As set forth above, the Action sets forth that absent specific compression steps not recited in the composition claims, the skilled artisan would expect the prior art compounds to provide the recited hardness. In response herein, the independent claims now more clearly distinguish over the combination of the Dobkowski et al., Anderson and Yoshimasa et al. references. Specifically, independent claims 1, 13, and 20 have been amended to include clarification that the compositions are obtained by compressing a loose powder composition. Additionally, new independent claim 29 (as well as dependent claims 30 to 39) has been added, and includes this same recitation. Consequently, the aforementioned cited references, whether

taken alone or in any combination, neither describe nor suggest all of the elements of the claims of the present application.

The products of this invention are pressed powder cosmetics, defined at page 4 of the instant application as "a composition of dry, free-flowing powder that has been compressed to a reduced volume and to a form such that, for example, when pressed into a rigid package, it will substantially maintain its shape and consistency regardless of the positioning of the package." Such pressed powder cosmetic products beneficially are portable, do not spill, and are hygienic. These advantages are offset in the conventional pressed powder products by not being sufficiently "powder-like". That is, the conventional products are hard to the touch, and are more difficult to apply because the make-up composition is less likely to adhere to the brush or other applicator. Typical pressed powder cosmetics also tend to be somewhat friable. In accordance with the present invention, the pressed powder compositions contain a silicone elastomer of low hardness, which results in a product form that has a certain degree of springiness and improved aesthetics. Consequently, the

claimed present invention provides pressed powder products that marry the benefits of the pressed powder products with the advantages of the powders.

Dobkowski et al. concerns the use of cross-linked siloxane elastomers in cosmetic powder compositions to incorporate water and water-soluble compounds into the powder system (see Col. 1, lines 29 et seq.), but nonetheless retaining the free-flowing powder nature of the composition. In this regard, Applicants refer to Example 1, Tables II and III of Dobkowski et al., in which the only example of the invention (Composition A) is a flowable powder. This reference does not contemplate pressed powders, or the benefits of the present invention. Dobkowski et al. lacks any guidance regarding suitable siloxane elastomers that could be used to provide pressed powder cosmetic compositions that have the exceptional resiliency of the products of the present invention, as shown in Figure 1.

Applicants submit that Yoshimasa et al. concerns solid cosmetic compositions containing organopolysiloxane elastomers that have a degree of JISA hardness from 50 to

100. Thus, Yoshimasa et al. uses siloxane elastomers of high hardness value. In contrast, the pressed cosmetic powder compositions of the present invention require siloxane elastomers that have a hardness of less than 45, preferably from 2 to less than 45, and more preferably about 4 to about 35, and optimally about 20 to 35, which degree of hardness is considerably less than what is required by Yoshimasa et al.

Moreover, there is no basis to combine Yoshimasa et al. with Dobkowski et al. The latter reference only concerns loose powders, and in particular loose powders that contain water, and especially aqueous emulsions. In a typical composition of the claimed present invention, the composition contains a liquid binder, which is typically a hydrophobic oil. The compositions of the present invention also typically contain up to about 25% of the silicone elastomer, by weight of the composition (See Claims 5 -7), as compared to the desired amount of the organopolysiloxane elastomer of high hardness value of 70 to 99% according to Yoshimasa et al.

Applicants note that Anderson is a European patent application first published September 26, 2001. As declared by Arvind Shah in the attached declaration under 37 C.F.R. 1.131(b), the present invention antedates the date of first publication of Anderson. Therefore, Anderson is not a proper prior art reference under §103(a). The Office Action's §103(a) rejection is based on the combination of Dobkowski et al. and Anderson, in view of Yoshimasa et al. As such, Applicants respectfully request reconsideration and withdrawal of the §103(a) rejection with regard to Anderson.

Additionally, there is nothing in the disclosure of Anderson to suggest that Anderson contemplates a pressed powder cosmetic. There is no guidance whatsoever as to the hardness index of the elastomer to be used. There is no motivation or basis to combine the teachings of Anderson with those of Yoshimasa et al., inasmuch as the latter concerns compositions having very high levels of the elastomer, as compared to the low levels of elastomer contemplated by Anderson.

Unlike the aforementioned cited references, independent claim 1 covers a pressed powder cosmetic composition having silicone elastomer particulates having a JISA hardness index less than about 45, wherein the pressed powder cosmetic composition is obtained by compressing a loose powder mixture. Independent claim 13 covers a pressed powder cosmetic composition having silicone elastomer particulates, wherein the pressed powder composition has a hardness value less than about 1500 grams, and the pressed powder cosmetic composition is obtained by compressing a loose powder mixture. Independent claim 20 covers a pressed powder cosmetic composition having silicone elastomer particulates, wherein the pressed powder composition has a percent recovery greater than about 25, and the pressed powder cosmetic composition is obtained by compressing a loose powder mixture. New independent claim 29 covers a pressed powder cosmetic composition having a mixture of a dry powder phase having silicone elastomer particulates and a liquid binder phase, wherein the pressed powder cosmetic composition is obtained by compressing the mixture, the silicone elastomer particulates having a JISA hardness index less than about 45.

In contrast to independent claims 1, 13, 20, and 29, and as conceded by the Examiner, there is nothing in any of the references that discloses or suggests that the pressed powder cosmetic composition is obtained by compressing a loose powder mixture. Additionally, the references also do not disclose or suggest the claimed hardness indexes. For these reasons, as well as for the reasons set forth above, independent claims 1, 13, 20, and 29 are patentably distinguishable.

Claims 2 to 12, 14 to 19, 21 to 25, and 30 to 39 depend from claims 1, 13, 20, and 29, respectively, so they are also patentable for at least the same reasons as discussed above with respect to claims 1, 13, 20, and 29.

Claims 1 to 7 were rejected under 35 U.S.C. § 102(b) as being anticipated by Yoshimasa et al. Applicants respectfully traverse this rejection on the grounds that the Yoshimasa et al. reference neither describes nor suggests all of the elements set forth in the independent claims of this application.

Concerning the §102(b) rejection of claims 1 to 7, independent claim 1 covers the novel and nonobvious appreciation that a pressed powder cosmetic composition having silicone elastomer particulates with a JISA hardness index less than about 45, wherein the pressed powder cosmetic composition is obtained by compressing a loose powder mixture, provides for a composition with improved benefits. Some of these same benefits, as previously discussed with regard to the §103 rejections, are that when these compositions are pressed into a rigid package, they will substantially maintain their shape and consistency regardless of the positioning of the package, and are beneficially portable, do not spill, and hygienic. Such a composition for the aforementioned resulting benefits is not provided by the prior art.

The Office Action broadly states that Yoshimasa et al. anticipates the present invention. Although not expressly outlined in the Action, this argument appears to be based primarily in that Yoshimasa et al. discloses some of the same ingredients as those disclosed in the claimed present invention. However, Yoshimasa et al. fails to appreciate a critical point of the claimed present invention.

Specifically, while Yoshimasa et al. discloses fine spherical particles of an organopolysiloxane elastomer having 50-100, preferably 50-80 JISA hardness, and 0.1-200, preferably 0.5-20.0 micrometers mean particle diameter, the present invention claims a pressed powder cosmetic composition having silicone elastomer particulates having a JISA hardness index less than about 45, where the pressed powder cosmetic composition is obtained by compressing a loose powder mixture in independent claim 1. The Yoshimasa et al. patent neither discloses nor suggests using silicone elastomer particulates having such a low hardness index or where the pressed powder cosmetic composition is obtained by compressing a loose powder mixture as disclosed in the claimed present invention.

Applicants submit that Yoshimasa et al. does not describe all of the elements set forth in claim 1. Thus, Yoshimasa et al. does not anticipate claim 1. Accordingly, Applicants respectfully request reconsideration and withdrawal of the section 102(b) rejection of claim 1.

Claims 2 to 7 depend from claim 1, so they are not anticipated by Yoshimasa et al. and also patentably

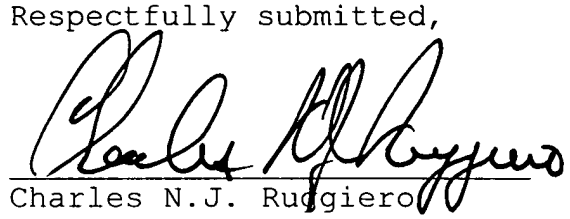
distinguishable for at least the same reasons as discussed above with respect to claim 1. Additionally, claims 2 to 4 are further distinguishable on their own merits. Claims 2 to 4 cover silicone elastomer particulates having a JISA hardness index from about 2 to less than about 45, from about 4 to about 35, and from about 20 to about 35, respectively.

New independent claim 29 and dependent claims 30 to 39 are not anticipated by Yoshimasa et al., and are also patentably distinguishable, for analogous reasons as discussed above with respect to claims 1 to 7.

In view of the foregoing, Applicants respectfully submit that the claims of the present invention are allowable, and request that the rejections be reconsidered and withdrawn. Applicants respectfully urge that the claims of this application be given favorable consideration and immediate passage to allowance. In the event that further clarification is required prior to allowance, applicants respectfully request that the Examiner contact Applicants' undersigned attorney.

Dated: March 3, 2004

Respectfully submitted,



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Attachment A

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	China et al.
Serial No.:	10/032,787
For:	"PRESSED COSMETIC POWDER AND PROCESS FOR MAKING"
Filed:	December 26, 2001
Examiner:	Russell S. Travers
Art Unit:	1617
Confirmation No.:	7192
Customer No.:	27623

Attorney Docket No.: 679.0038USU

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION UNDER 37 C.F.R. §1.131

Dear Sir:

I, Arvind Shah, an applicant in the above-identified patent application, declare as follows:

1. That I am a citizen of the United States of America, and a resident of Suffern, New York.

2. That I hold a B.S. in Chemistry degree (1974) from M.S. University, Baroda, India; an M.S. in Organic Chemistry degree (1976), also form M.S. University, and an

M.S. in Cosmetic Science degree (1996) from Fairleigh Dickenson University.

3. That I have been employed in the cosmetic industry for 22 years.

4. That I have been continuously employed by Avon Products, Inc. since November 1994.

5. That I am a co-inventor of U.S. Patent Application Serial Number 10/032,787.

6. That sometime prior to September 26, 2001, we prepared a pressed powder cosmetic composition that included silicone elastomer particles that have a JISA hardness index less than about 45, a hardness value less than about 1500 grams and/or a percent recovery value greater than about 25, having superior aesthetics, such as springiness when touched.

7. Attached hereto is Exhibit A, which is four pages of notebook entries dated sometime prior to September 26, 2001, and showing the ingredients of the composition.

8. I further declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section

1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this application or any patent issuing thereon.

Declared at Suffern, New York, U.S.A.,
this 2nd day of March, 2004.

Arvind N Shah

Arvind Shah

EXHIBIT A

TITLE Spongy Pressed Powder for Face / Lip / Eye / Body

Project No.

Book No. 7876-20

From Page No.

Ref: Bobchina Notebook #1 – Page 25
& SDE-06249-06 Batch # 7148-64 – Asad

OK(30 LINES 100.00000% TOTAL) FORMULA FOR *CI 22493-01

1	RI	1966	13.20000% TALC-3 TO 4.5 MICRONS
2	PI	0743	10.00000% TALC-DIMETHICONE TRTD.(11%) (*RI*)
3	PI	9601	10.00000% TALC (SHEER)-DIMETHICONE TRTD.(11%) (*RI*)
4	RI	2331	5.00000% MICA-SILICA COATED (AMORPHOUS)
5	RI	1091	24-25.00000% NYLON POWDER-EXTRA FINE
6	RI	2178	3.50000% POLYMETHYL METHACRYLATE-SPHERICAL
7	RI	0885	7.50000% ZINC STEARATE
8	RI	3476	15.00000% POLYETHYLENE-12 MICRON
9	RI	0142	4.00000% CALCIUM SILICATE-HYDROUS
10	RI	3522	.25000% ACRYLATE COPOLYMER E0603
11	RI	0611	.25000% SILICA-FUMED
12	RI	0410	.30000% METHYLPARABEN
13	RI	0130	.20000% BUTYLPARABEN
14	RI	0297	.20000% IMIDAZOLIDINYL UREA
15	RI	2279	.75000% IRON OXIDE (COSMETIC RED)-LAUROYL LYSINE
16	RI	2281	1.20000% IRON OXIDE (YELLOW)-LAUROYL LYSINE
17	RI	2282	.35000% IRON OXIDE (BLACK)-LAUROYL LYSINE
18	RI	3940	.50000% DIMETHICONE 50 CST
19	RI	0258	.50000% DIMETHYL/TRIMETHYL POLYSILOXANE
20	RI	1964	.50000% SILICONE FLUID SF-96-5
21	RI	2630	.60000% CETYL DIMETHICONE COPOLYOL
21	RI	0497	.5000% Paraffin Wax – High Penetration

1.00 % Dow Corning 9506 Powder
(Dimethyl, Methyl Silicone Resin & Polyethylene oxide lauryl ether)

100.00

Witnessed & Understood by me,

Date

Invented by Arvind Shah

Recorded by

Date

To Page No.

TITLE Spongy Pressed Powder for Face/Lip/Eye/Body

Project No.

Book No. 7876-21

From Page No.

Ref: Bobchina Note book # 1 - Page 25
& A Shah - Book # 7148-64 for # 06249-06

OK(30 LINES 100.00000% TOTAL) FORMULA FOR *CI 22493-01 02

1	RI	1966	13.20000%	TALC-3 TO 4.5 MICRONS
2	PI	0743	10.00000%	TALC-DIMETHICONE TRTD.(11%) (*RI*)
3	PI	9601	10.00000%	TALC (SHEER)-DIMETHICONE TRTD.(11%) (*RI*)
4	RI	2331	5.00000%	MICA-SILICA COATED (AMORPHOUS)
5	RI	1091	24.00 ~~25.00000%~~	NYLON POWDER-EXTRA FINE
6	RI	2178	3.50000%	POLYMETHYL METHACRYLATE-SPHERICAL
7	RI	0885	7.50000%	ZINC STEARATE
8	RI	3476	15.00000%	POLYETHYLENE-12 MICRON
9	RI	0142	4.00000%	CALCIUM SILICATE-HYDROUS
10	RI	3522	.25000%	ACRYLATE COPOLYMER E0603
11	RI	0611	.25000%	SILICA-FUMED
12	RI	0410	.30000%	METHYLPARABEN
13	RI	0130	.20000%	BUTYLPARABEN
14	RI	0297	.20000%	IMIDAZOLIDINYL UREA
15	RI	2279	.75000%	IRON OXIDE (COSMETIC RED)-LAUROYL LYSINE
16	RI	2281	1.20000%	IRON OXIDE (YELLOW)-LAUROYL LYSINE
17	RI	2282	.35000%	IRON OXIDE (BLACK)-LAUROYL LYSINE
18	RI	3940	.50000%	DIMETHICONE 50 CST
19	RI	0258	.50000%	DIMETHYL/TRIMETHYL POLYSILOXANE
20	RI	1964	.50000%	SILICONE FLUID SF-96-5
21	RI	2630	.60000%	CETYL DIMETHICONE COPOLYOL
22	RI	0497	.50 %	Paraffinwax-High Penetration

1.00 % Dow Corning (9505) 29-111 Powder

100.00

(Dimethyl Methyl Siloxane resin
Polydimethylsiloxane
Polyethylene oxide lauryl ether)

To Page No.

Witnessed & Understood by me,	Date	Invented by	Date
H. Patel		Recorded by	

TITLE Spongy Pressed Powder For Face/Lip/Eye/Body

Project No.

Book No. 7876-22

From Page No.

Ref Bob Chimals Note Book # 1 - Page 25. &
OR 7876-20 & A Shah Book # 7148-64 fm # 08249-06

OK (30 LINES 100.00000% TOTAL) FORMULA FOR *CI 22493-~~01~~03

1	RI	1966	~~13.20000%~~	TALC-3 TO 4.5 MICRONS
2	PI	0743	~~10.00000%~~	TALC-DIMETHICONE TRTD.(11%) (*RI*)
3	PI	9601	10.00000%	TALC (SHEER)-DIMETHICONE TRTD.(11%) (*RI*)
4	RI	2331	~~5.00000%~~	MICA-SILICA COATED (AMORPHOUS)
5	RI	~~1091~~	~~5.00000%~~	~~NYLON POWDER-EXTRA FINE~~
6	RI	2178	3.50000%	POLYMETHYL METHACRYLATE-SPHERICAL
7	RI	0885	7.50000%	ZINC STEARATE
8	RI	3476	15.00000%	POLYETHYLENE-12 MICRON
9	RI	0142	4.00000%	CALCIUM SILICATE-HYDROUS
10	RI	3522	.25000%	ACRYLATE COPOLYMER E0603
11	RI	0611	.25000%	SILICA-FUMED
12	RI	0410	.30000%	METHYLPARABEN
13	RI	0130	.20000%	BUTYLPARABEN
14	RI	0297	.20000%	IMIDAZOLIDINYL UREA
15	RI	2279	.75000%	IRON OXIDE (COSMETIC RED)-LAUROYL LYSINE
16	RI	2281	1.20000%	IRON OXIDE (YELLOW)-LAUROYL LYSINE
17	RI	2282	.35000%	IRON OXIDE (BLACK)-LAUROYL LYSINE
18	RI	3940	~~.50000%~~	DIMETHICONE 50 CST
19	RI	0258	~~.50000%~~	DIMETHYL/TRIMETHYL POLYSILOXANE
20	RI	1964	~~.60000%~~	SILICONE FLUID SF-96-5
21	RI	2630	~~.60000%~~	CETYL DIMETHICONE COPOLYOL
22	RI	0497	2.000	Pumpkin Wax - high Penetrating

20.00 % DOW Corning 9506 Powder
(Dimethyl Methyl silicone Resin
Polymethylene oxide lauryl ether)
100.00

To Page No.

Witnessed & Understood by me,	Date	Invented by A Shah	Date
		Recorded by	

TITLE Spongy Pressed Powder Fnd (Face) Lip) Eye) Body Project No. _____ Book No. 7876-23

From Page No. —

Ref: 7876-21 Ref: Aslan's Book # 7148-64 formula # DI 06249-06
Bobchina's Note Book #1 - Page 25

OK (30 LINES 100.00000% TOTAL) FORMULA FOR *CI 22493-~~01~~04

1	RI	1966	1.00	~~12.20000~~%	TALC-3 TO 4.5 MICRONS
2	PI	0743	15.08	~~10.00000~~%	TALC-DIMETHICONE TRTD.(11%) (*RI*)
3	PI	9601		10.00000%	TALC (SHEER)-DIMETHICONE TRTD.(11%) (*RI*)
4	RI	2381	0.10	~~5.00000~~%	MICA-SILICA COATED (AMORPHOUS)
5	RI	1091	5.00	~~5.00000~~%	NYLON POWDER-EXTRA FINE
6	RI	2178		~~3.50000~~%	POLYMETHYL METHACRYLATE-SPHERICAL
7	RI	0885		7.50000%	ZINC STEARATE
8	RI	3476		15.00000%	POLYETHYLENE-12 MICRON
9	RI	0142		4.00000%	CALCIUM SILICATE-HYDROUS
10	RI	3522		.25000%	ACRYLATE COPOLYMER E0603
11	RI	0611		.25000%	SILICA-FUMED
12	RI	0410		.30000%	METHYLPARABEN
13	RI	0130		.20000%	BUTYLPARABEN
14	RI	0297		.20000%	IMIDAZOLIDINYL UREA
15	RI	2279		.75000%	IRON OXIDE (COSMETIC RED)-LAUROYL LYSINE
16	RI	2281		1.20000%	IRON OXIDE (YELLOW)-LAUROYL LYSINE
17	RI	2282		.35000%	IRON OXIDE (BLACK)-LAUROYL LYSINE
18	RI	3940	3.9	~~.50000~~%	DIMETHICONE 50 CST
19	RI	0258	3.9	~~.50000~~%	DIMETHYL/TRIMETHYL POLYSILOXANE
20	RI	1964	3.9	~~.50000~~%	SILICONE FLUID SF-96-5
21	RI	2630	1.5	~~.50000~~%	CETYL DIMETHICONE COPOLYOL
22	RI	0497	2.5	5.00000%	Paraffin wax - high penetrating

20.00% Dow Corning (9505) or 29-111 Powder
(Dimethyl, Methyl Silicone Resin
Polydimethyl Siloxane
Polyethylene Oxide Lauryl ether)

To Page No. —

Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	

Attachment B

JIS

JAPANESE INDUSTRIAL STANDARD

Translated and Published by
Japanese Standards Association

JIS K 6253 : 1997

Hardness testing methods for rubber, vulcanized or thermoplastic

ICS 83.060

Descriptors : vulcanized rubber, vulcanized materials, hardness testing, mechanical testing, hardness, mechanical properties of materials

Reference number : JIS K 6253 : 1997 (E)

K 6253 : 1997

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of International Trade and Industry through deliberations at Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law:

Date of Establishment: 1998-02-01

Date of Revision: 1997-04-20

Date of Public Notice in Official Gazette: 1997-04-21

Investigated by: Japanese Industrial Standards Committee
Divisional Council on Chemical

JIS K 6253:1997, First English edition published in 1998-12

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

In the event of any doubts arising as to the contents, the original JIS is to be the final authority.

JAPANESE INDUSTRIAL STANDARD JIS K 6253 : 1997

Hardness testing methods for rubber, vulcanized or thermoplastic

Introduction This Japanese Industrial Standard has been prepared on the basis of the 3rd edition of **ISO 48**, *Rubber, vulcanized or thermoplastic—Determination of hardness (hardness between 10 IRHD and 100 IRHD)* published in 1994, and the 1st edition of **ISO 7619**, *Rubber—Determination of indentation hardness by means of pocket hardness meters* published in 1986, without any modification in technical contents. However, "Type E of spring type (durometer hardness)" which is not specified in the corresponding International Standards are added in this Standard.

1 Scope This Japanese Industrial Standard specifies the testing methods to measure hardness of vulcanized rubber and thermoplastic rubber (hereafter referred to as "vulcanized rubber").

Remarks 1 The standards cited in this Standard are listed as follows.

JIS K 6200 *Glossary of terms used in rubber industry*

JIS K 6250 *General rules of physical testing methods for rubber, vulcanized or thermoplastic*

JIS Z 8401 *Rules for rounding off of numerical values*

2 The International Standards corresponding to this Standard are listed as follows.

ISO 48 : 1994 *Rubber, vulcanized or thermoplastic—Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 7619 : 1986 *Rubber—Determination of indentation hardness by means of pocket hardness meters*

3 The units and numerical values given in ( ) in this Standard are based on traditional units, and are appended for informative reference.

2 Definitions For the purposes of this Standard, the definitions given in **JIS K 6200** and **JIS K 6250**, and the following definitions apply.

(1) **international rubber hardness degree** Hardness which can be obtained through conversion into international rubber hardness degree (IRHD)(1) using the depth of indentation by a plunger when the plunger, with a ball-type lower end, is vertically impressed on the surface of a test piece with specified indenting force.

A hardness scale is chosen so that "0" represents the hardness of material having a Young's modulus of zero and "100" represents the hardness of a material of infinite Young's modulus, and the following conditions are fulfilled over most of normal range of hardness.

(a) One international rubber hardness degree always represents approximately the same proportionate difference in the Young's modulus.

(b) For highly elastic rubber, the scales of international rubber hardness degree and that of type A durometer are comparable.

Note (1) IRHD International Rubber Hardness Degree

(2) **durometer hardness** The hardness given by the testing apparatus (durometer) which reads the indentation depth made by a specifically shaped indentor when it is impressed on the surface of a test piece via a spring.

(3) **IRHD pocket hardness** The hardness given by a portable pocket testing apparatus (IRHD pocket hardness meter) by which international rubber hardness degree can be conveniently obtained owing to reading the indented depth made by an indentor, with a ball-type lower end, when it impressed on the surface of a test piece via a spring.

(4) **standard hardness** The hardness obtained using the specified procedures on test pieces whose shape and dimensions satisfy the specifications, when carrying out each test.

(5) **apparent hardness** The hardness obtained either using other procedures than the specified, or on the test piece whose shape and dimensions do not satisfy the specification, when carrying out each test.

3 Type of test

3.1 Outline of hardness test There are many types of testing methods for hardness test depending on the principle of hardness measurement, range of hardness measurement, kind of testing apparatus and so on, and they are classified into standard hardness and apparent hardness by shape or dimensions of a test piece. The outline of classifying is shown in Table 1.

Table 1 Outline of hardness tests

Principle of measurement	Range of hardness measurement	Type of testing apparatus	Testing method	Test condition for standard hardness		
				Shape	Thickness mm	Minimum distance from the edge of sample mm
Constant-force type (international rubber hardness degree)	For high hardness (85 to 100 IRHD)	Normal size international rubber hardness meter	H method	Both upper and lower surfaces are smooth and parallel each other.	8.0 min.	9.0
					10.0 max.	10.0
	For normal hardness (30 to 95 IRHD)	Normal size international rubber hardness meter	N method		8.0 min.	9.0
					10.0 max.	10.0
		Microsize international rubber hardness meter	M method		1.5 min.	2.0
					2.5 max.	
	For low hardness (10 to 35 IRHD)	Normal size international rubber hardness meter	L method		10.0 min.	10.0
					15.0 max.	11.5
Spring type (durometer hardness)	For high hardness (A90 or more)	Type D durometer			6.0 or more	12.0
	For normal hardness (A10 to 90)	Type A durometer			6.0 or more	12.0
	For low hardness (A20 or less)	Type E durometer			10.0 or more	12.0
Spring type (IRHD pocket hardness)	For normal hardness (30 to 95 IRHD)	IRHD pocket hardness meter	P method		6.0 or more	12.0

3.2 Type of tests The type of hardness tests for vulcanized rubber shall be classified as follows.

(1) **International rubber hardness test**

(a) H method (normal size test for high hardness)

(b) N method (normal size test for normal hardness)

(c) M method (microsize test for normal hardness)

(d) L method (normal size test for low hardness)

(2) **Durometer hardness test**

(a) Type D (test for high hardness)

(b) Type A (test for normal hardness)

(c) Type E (test for low hardness)

(3) **IRHD pocket hardness test**

(a) P method (for normal hardness)

4 International rubber hardness test

4.1 Purpose This test shall be carried out to measure the international rubber hardness degree of vulcanized rubber.

4.2 Range of measurement The measuring range of this test is decided according to the thickness and hardness of a test piece for every testing method. The measuring range of each testing method is as follows.

(1) **H method** Formal measuring range shall be for the test piece measuring 8.0 mm to 10.0 mm in thickness and with hardness of 85 IRHD to 100 IRHD. It is permissible to test the one with 4.0 mm or more thickness and with hardness of 85 IRHD to 100 IRHD.

(2) **N method** Formal measuring range shall be for the test piece measuring 8.0 mm to 10.0 mm in thickness and with hardness of 35 IRHD to 85 IRHD. It is permissible to test the one with 4.0 mm or more thickness and with hardness of 30 IRHD to 95 IRHD(2).

(3) **M method** Formal measuring range shall be for the test piece measuring 1.5 mm to 2.5 mm in thickness and with hardness of 35 IRHD to 85 IRHD. It is permissible to test the one with 1.0 mm to 4.0 mm thickness and with hardness of 30 IRHD to 95 IRHD(2).

(4) **L method** Formal measuring range shall be for the test piece measuring 10.0 mm to 15.0 mm in thickness and with hardness of 10 IRHD to 35 IRHD. It is permissible to test the one with 6.0 mm or more thickness and with hardness of 10 IRHD to 35 IRHD.

Notes (2) The hardness values in 85 IRHD to 95 IRHD and 30 IRHD to 35 IRHD obtained by N method do not exactly coincide with the values by H method and L method, but the discrepancy does not come into technical problem, generally speaking.

(3) The testing apparatus for M method is the one prepared by miniaturizing the testing apparatus for N method by about one-sixth to measure the test piece with thin thickness, therefore the depth of plunger indentation by M method is just one-sixth that by N method. The results given by M method are not always coincident with the results given by N method because of the surface effect of rubber or slight roughness of the surface.

4.3 Testing apparatus

4.3.1 Outline of testing apparatus The testing apparatus is composed of a holding base for test piece by which a test piece is kept, an annular pressure foot by which the surface of a test piece is pressed, a plunger, with a ball-type lower end, set at the center of hole of pressure foot, a device for loading which gives an indenting force on a plunger to make an indentation on a test piece, a measuring device to measure depth of an indentation impressed on a test piece, and a vibrating device to lessen friction. The dimensions of main parts and the specification of force are shown in Table 2.

A thermostat may be provided for measuring a test temperature other than standard condition of laboratory.

Table 2 Main dimensions and forces of testing apparatus

Type of tests	Diameter of ball of plunger end mm	Face of pressure foot			Force applying at ball of plunger end		
		Diameter mm	Diameter of hole mm	Force exerted on face of pressure foot	Contact force	Indenting force	Total
H method	1.00±0.01	20±1	6±1	8.3±1.5 N {846±153 gf}	0.30±0.02 N {30.6±2.0 gf}	5.40±0.01 N {550.6±1.0 gf}	5.70±0.03 N {581.2±3.1 gf}
N method	2.50±0.01	20±1	6±1				
L method	5.00±0.01	22±1	10±1				
M method	0.395±0.005	3.35±0.15	1.00±0.15	235±30 mN (4) {24.0±3.1 gf}	8.3±0.5 mN {0.85±0.05 gf}	145±0.5 mN {14.79±0.05 gf}	153±1 mN {15.60±0.10 gf}

Note (4) When in M method a pressure adjusting spring installed at the bottom of a test-piece holding base makes pressure adjustment, the pressure adjusting spring must be controlled to be (380±30) mN {(38.7±3.1) gf} because an indenting force 145 mN {14.8 gf} is added during measurement.

4.3.2 Face of pressure foot An annular pressure foot makes rectangular to a plunger. The diameter of face of pressure foot and the diameter of the hole for a plunger are as shown in Table 2. When the force exerted on the face of pressure foot is just as shown in Table 2, the pressure impressed on the surface of test piece becomes (30±5) kPa {(0.306±0.051) kgf/cm²}(5). In order to measure the relative displacement between the face of pressure foot (upper surface of test piece) and the plunger, the face of pressure foot shall be firmly united with the measuring device of the depth of indentation.

Note (5) Some combination of all tolerances shown in Table 2 does not always give nice coincidence with the description of pressure (30±5) kPa {(0.306±0.051) kgf/cm²}.

4.3.3 **Plunger** The plunger shall be vertical, and its lower end has spherical shape whose diameter shall be as shown in Table 2(6). The lower end ball of a plunger shall be kept a little upper than the face of pressure foot before contact force is applied.

Note (6) The material of end ball shall be abrasion resistant and corrosion resistant.

When an end ball is connected with the body of plunger, the connected part must not be larger than diameter of the ball.

4.3.4 **Loading device** Loading device shall accurately apply the contact force(7) and indenting force(8) specified in Table 2 to the end ball of a plunger.

Notes (7) Contact force means the force causing the end ball of a plunger to contact with surface of a test piece.

(8) Indenting force means the force to impress the end ball of a plunger into test piece after making contact.

4.3.5 **Measuring device of indented depth** The measuring device for indented depth shall be capable of measuring indented depth of a plunger when indenting force is applied to a plunger, by which the indented depth or IRHD shall be directly read(9). The conversion from indented depth to IRHD can be done through Table 3, Table 4 and Table 5(10).

Notes (9) For the measuring device of indented depth, any of mechanical, optical, or electrical, is serviceable.

(10) Table 3 is for the conversion of H method, and Table 4 for N method. In case of M method, convert after making the indented depth shown in Table 4 one-sixth. Table 5 is the conversion table for L method.

4.3.6 **Vibrating device** To overcome minute friction, it is preferable to install a vibrating device like an electric buzzer by which a testing apparatus is suitably vibrated. It can be eliminated if friction is completely removed.

4.3.7 **Thermostat** The thermostat is needed when the test temperature other than standard condition of laboratory is employed for measuring hardness. The thermostat must keep the specified temperature in the tolerance of ±2 °C. The annular foot with pressure face at lower end and a plunger shall penetrate through the upper part of the thermostat.

The part through which the plunger penetrates shall be made of the material with small thermal conductivity. The sensor for temperature measurement shall be installed at holding place of test piece or its vicinity, in the thermostat.

Table 3 Conversion table from indented depth (D) of a plunger to international rubber hardness degree (IRHD) (H method)

D mm	International rubber hardness degree IRHD	D mm	International rubber hardness degree IRHD	D mm	International rubber hardness degree IRHD
0.00	100.0	0.15	97.3	0.30	91.1
0.01	100.0	0.16	97.0	0.31	90.7
0.02	100.0	0.17	96.6	0.32	90.2
0.03	99.9	0.18	96.2	0.33	89.7
0.04	99.9	0.19	95.8	0.34	89.3
0.05	99.8	0.20	95.4	0.35	88.8
0.06	99.6	0.21	95.0	0.36	88.4
0.07	99.5	0.22	94.6	0.37	87.9
0.08	99.3	0.23	94.2	0.38	87.5
0.09	99.1	0.24	93.8	0.39	87.0
0.10	98.8	0.25	93.4	0.40	86.6
0.11	98.6	0.26	92.9	0.41	86.1
0.12	98.3	0.27	92.5	0.42	85.7
0.13	98.0	0.28	92.0	0.43	85.3
0.14	97.6	0.29	91.6	0.44	84.8

Table 4 Conversion table from indented depth (D) of a plunger to international rubber hardness degree (IRHD) (N method)

D mm	International rubber hardness degree IRHD	D mm	International rubber hardness degree IRHD	D mm	International rubber hardness degree IRHD	D mm	International rubber hardness degree IRHD
0.00	100.0	0.45	73.9	0.90	52.3	1.35	38.9
0.01	100.0	0.46	73.3	0.91	52.0	1.36	38.7
0.02	99.9	0.47	72.7	0.92	51.6	1.37	38.4
0.03	99.8	0.48	72.2	0.93	51.2	1.38	38.2
0.04	99.6	0.49	71.6	0.94	50.9	1.39	38.0
0.05	99.3	0.50	71.0	0.95	50.5	1.40	37.8
0.06	99.0	0.51	70.4	0.96	50.2	1.41	37.5
0.07	98.6	0.52	69.8	0.97	49.8	1.42	37.3
0.08	98.1	0.53	69.3	0.98	49.5	1.43	37.1
0.09	97.7	0.54	68.7	0.99	49.1	1.44	36.9
0.10	97.1	0.55	68.2	1.00	48.8	1.45	36.7
0.11	96.5	0.56	67.6	1.01	48.5	1.46	36.5
0.12	95.9	0.57	67.1	1.02	48.1	1.47	36.2
0.13	95.3	0.58	66.6	1.03	47.8	1.48	36.0
0.14	94.7	0.59	66.0	1.04	47.5	1.49	35.8
0.15	94.0	0.60	65.5	1.05	47.1	1.50	35.6
0.16	93.4	0.61	65.0	1.06	46.8	1.51	35.4
0.17	92.7	0.62	64.5	1.07	46.5	1.52	35.2
0.18	92.0	0.63	64.0	1.08	46.2	1.53	35.0
0.19	91.3	0.64	63.5	1.09	45.9	1.54	34.8
0.20	90.6	0.65	63.0	1.10	45.6	1.55	34.6
0.21	89.8	0.66	62.5	1.11	45.3	1.56	34.4
0.22	89.2	0.67	62.0	1.12	45.0	1.57	34.2
0.23	88.5	0.68	61.5	1.13	44.7	1.58	34.0
0.24	87.8	0.69	61.1	1.14	44.4	1.59	33.8
0.25	87.1	0.70	60.6	1.15	44.1	1.60	33.6
0.26	86.4	0.71	60.1	1.16	43.8	1.61	33.4
0.27	85.7	0.72	59.7	1.17	43.5	1.62	33.2
0.28	85.0	0.73	59.2	1.18	43.3	1.63	33.0
0.29	84.3	0.74	58.8	1.19	43.0	1.64	32.8
0.30	83.6	0.75	58.3	1.20	42.7	1.65	32.6
0.31	82.9	0.76	57.9	1.21	42.5	1.66	32.4
0.32	82.2	0.77	57.5	1.22	42.2	1.67	32.3
0.33	81.5	0.78	57.0	1.23	41.9	1.68	32.1
0.34	80.9	0.79	56.6	1.24	41.7	1.69	31.9
0.35	80.2	0.80	56.2	1.25	41.4	1.70	31.7
0.36	79.5	0.81	55.8	1.26	41.1	1.71	31.6
0.37	78.9	0.82	55.4	1.27	40.9	1.72	31.4
0.38	78.2	0.83	55.0	1.28	40.6	1.73	31.2
0.39	77.6	0.84	54.6	1.29	40.4	1.74	31.1
0.40	77.0	0.85	54.2	1.30	40.1	1.75	30.9
0.41	76.4	0.86	53.8	1.31	39.9	1.76	30.7
0.42	75.8	0.87	53.4	1.32	39.6	1.77	30.5
0.43	75.2	0.88	53.0	1.33	39.4	1.78	30.4
0.44	74.5	0.89	52.7	1.34	39.1	1.79	30.2
						1.80	30.0

Table 5 Conversion table from indented depth (D) of a plunger to international rubber hardness degree (IRHD) (L method)

D mm	International rubber hardness degree IRHD	D mm	International rubber hardness degree IRHD	D mm	International rubber hardness degree IRHD
1.10	34.9	1.80	21.3	2.50	14.1
1.12	34.4	1.82	21.1	2.52	14.0
1.14	33.9	1.84	20.8	2.54	13.8
1.16	33.4	1.86	20.6	2.56	13.7
1.18	32.9	1.88	20.3	2.58	13.5
1.20	32.4	1.90	20.1	2.60	13.4
1.22	31.9	1.92	19.8	2.62	13.3
1.24	31.4	1.94	19.6	2.64	13.1
1.26	30.9	1.96	19.4	2.66	13.0
1.28	30.4	1.98	19.2	2.68	12.8
1.30	30.0	2.00	18.9	2.70	12.7
1.32	29.6	2.02	18.7	2.72	12.6
1.34	29.2	2.04	18.5	2.74	12.5
1.36	28.8	2.06	18.3	2.76	12.3
1.38	28.4	2.08	18.0	2.78	12.2
1.40	28.0	2.10	17.8	2.80	12.1
1.42	27.6	2.12	17.6	2.82	12.0
1.44	27.2	2.14	17.4	2.84	11.8
1.46	26.8	2.16	17.2	2.86	11.7
1.48	26.4	2.18	17.0	2.88	11.6
1.50	26.1	2.20	16.8	2.90	11.5
1.52	25.7	2.22	16.6	2.92	11.4
1.54	25.4	2.24	16.4	2.94	11.3
1.56	25.0	2.26	16.2	2.96	11.2
1.58	24.7	2.28	16.0	2.98	11.1
1.60	24.4	2.30	15.8	3.00	11.0
1.62	24.1	2.32	15.6	3.02	10.9
1.64	23.8	2.34	15.4	3.04	10.8
1.66	23.5	2.36	15.3	3.06	10.6
1.68	23.1	2.38	15.1	3.08	10.5
1.70	22.8	2.40	14.9	3.10	10.4
1.72	22.5	2.42	14.8	3.12	10.3
1.74	22.2	2.44	14.6	3.14	10.2
1.76	21.9	2.46	14.4	3.16	10.1
1.78	21.6	2.48	14.3	3.18	9.9

4.4 Test piece

4.4.1 Shape of test pieces Both surfaces of a test piece shall be smoothly flat and parallel each other(11). This test has been supposed to compare the test pieces having the same thickness.

Note (11) The surface such as unsmoothed, curved, or rough, does not give satisfactory results. For specially formed surface, however, such as rubber roll, this method can be applied.

The international rubber hardness testing method for curved test piece is shown in Informative reference.

4.4.2 Thickness

(1) **H method and N method** The standard thickness of a test piece is 8.0 mm to 10.0 mm, but to get necessary thickness, it is permissible to pile smooth and parallel test pieces. Provided that the thickness of test pieces before piling shall be 2 mm or more, and 3 or more test pieces cannot be piled up. Even when nonstandard test piece other than above(12) is to be adopted, the thickness of the test piece must be 4.0 mm or more.

(2) **L method** The standard thickness of a test piece is 10.0 mm to 15.0 mm, but to get necessary thickness, it is permissible to pile smooth and parallel test pieces. Provided that the thickness of test pieces before piling shall be 2 mm or more, and 3 or more test pieces cannot be piled up. Even when nonstandard test piece other than above(12) is to be adopted, the thickness of the test piece must be 6.0 mm or more.

(3) **M method** The standard thickness of a test piece is (2.0 ±0.5) mm. Even when nonstandard test piece other than above(12) is to be adopted, the thickness of the test piece must be 1.0 mm or more.

Note (12) The measured value resulted from nonstandard test piece, is not generally coincident with the measured value by standard test piece.

4.4.3 Lateral dimensions

(1) **H method, N method, and L method** The lateral dimension of a test piece shall be large enough to measure at the point which is apart from edge of the test piece by at least the distance shown in Table 6.

Table 6 Minimum distance of point for hardness measurement (point of end ball of plunger) from test-piece edge

Unit: mm

Thickness of a test piece	Minimum distance of point for hardness measurement from test-piece edge
4.0	7.0
6.0	8.0
8.0	9.0
10.0	10.0
15.0	11.5
25.0	13.0

(2) **M method** The lateral dimension of a test piece shall be large enough to measure at the point which is apart from edge of the test piece by at least 2.0 mm. When the test piece, with the thickness of 4.0 mm or more, which is not eligible for N method because of small lateral dimension or of not having large smooth area, is to be tested by M method, carry out test at the point apart from edge of the test piece as far as possible.

4.4.4 Sampling and preparation of test pieces The sampling and preparation of test pieces shall principally follow **6.5** of **JIS K 6250**.

4.4.5 Selection of test pieces The test pieces which contain alien matters, bubbles, or flaws shall not be used for tests.

4.5 Testing method

4.5.1 Testing conditions Testing conditions shall be as follows.

(1) The standard conditions of a laboratory shall follow **6.1** of **JIS K 6250**.

(2) Storing of sample and test pieces shall follow **6.2** of **JIS K 6250**.

(3) The standard conditions of test pieces shall follow **6.3** of **JIS K 6250**.

4.5.2 Procedures Sprinkle slightly talc on upper and back surfaces of a test piece to lessen friction between the end ball of a plunger and surface of a test piece. Place the test piece on the holding base of a test piece. Make the face of pressure foot touch with the surface of the test piece.

(1) When the scale is graduated with IRHD, apply contact force to the plunger for 5 s, and adjust the scale to be 100. Then, apply indenting force for 30 s, and read directly hardness by IRHD.

(2) When the scale is graduated with indented depth, apply contact force to the plunger for 5 s, and read the scale. Then, apply indenting force for 30 s, and read the scale. Calculate the difference between indentation by contact force and that by indenting force, and make this the indented depth D. Convert the value of D into IRHD making use of Table 3, Table 4, and Table 5.

While applying force, the slight vibration may be applied on the testing apparatus by a vibrating device to overcome the friction. Carry out measurements at 3 or 5 new points on a test piece at every measurement.

4.6 Arrangement of test results Round off the median of 3 or 5 measurements to whole number according to **JIS Z 8401**, and mark the sign IRHD after it. In case of standard hardness, after it mark "/" together with letter "S", and then mark "/" with sign as H, N, M, or L, which means testing method. In case of apparent hardness, after sign of IRHD mark "/" together with sign as H, N, M, or L, which means testing method.

Example 1 50 IRHD/S/N: means that standard test piece is measured by N method of international rubber hardness test, and standard hardness is 50 IRHD.

Example 2 50 IRHD/M: means that nonstandard test piece is measured by M method of international rubber hardness test, and apparent hardness is 50 IRHD.

4.7 **Record** On test result, the following items shall be recorded.

(1) Test result

(2) Shape and dimensions of test piece (whether standard test piece or nonstandard one; in case of nonstandard, whether curved surface or not; and in case of piled one, the number of piled pieces and its thickness)

(3) Sampling and preparation methods of test pieces

(4) Test temperature

(5) Other items specially needed

5 Durometer hardness test

5.1 **Purpose** This test shall be carried out to measure durometer hardness of vulcanized rubber.

5.2 **Range of measurement** The measuring range of this test is decided according to the hardness of test piece at every testing method. The measuring range of each testing method is as follows.

(1) **Type D durometer** The measuring range of type D durometer hardness is the range over A90 by type A durometer. When less than D20, measure by type A durometer.

(2) **Type A durometer** The measuring range of type A durometer hardness is from A10 to A90, and when over A90, measure by type D durometer. When less than A20, measure by type E durometer.

(3) **Type E durometer** The measuring range of type E durometer hardness is the range of less than A20 by type A durometer.

5.3 **Testing apparatus**

5.3.1 **Outline of testing apparatus** The testing apparatus is composed of the face of pressure foot by which the surface of a test piece is pressed, indentor which protrudes from a central hole of face of pressure foot by action of a spring, and the graduation which indicates the distance (indenting depth) of indentor rejected by rubber cushion and which represents hardness itself.

5.3.2 **Face of pressure foot** The face of pressure foot is perpendicular to the indentor, and its center has a hole for the indentor. The diameter of the hole, in case of type D and type A durometer, is $3.0^{+0.2}_{-0.5}$ mm, and in case of type E durometer, (5.4 ± 0.2) mm.

On the face of pressure foot, the distance from any place of its outer edge to the center of an indentor shall be, in case of type D and type A durometer, 6 mm or more, and in case of type E durometer, 7 mm or more.

5.3.3 Indentor The material of indentor shall be abrasion resistant and corrosion resistant, and it shall be accurately fixed at center of the hole of face of pressure foot. Its shape and dimensions are indicated in Fig. 1 for type D durometer, in Fig. 2 for type A durometer, and in Fig. 3 for type E durometer.

Unit : mm

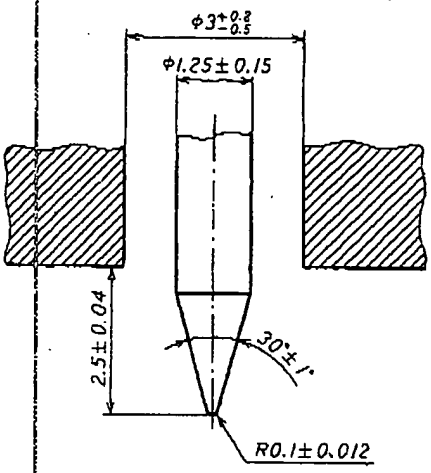


Fig. 1 Indentor for type D durometer

Unit : mm

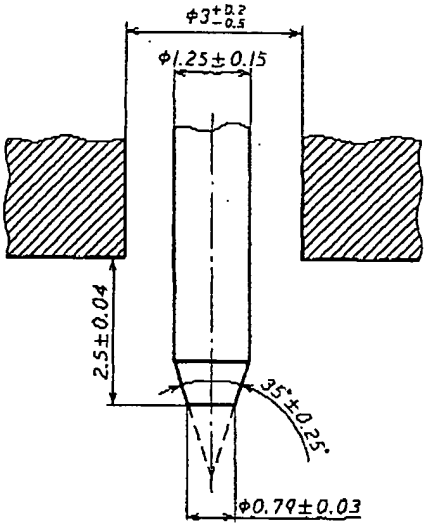


Fig. 2 Indentor for type A durometer

Unit : mm

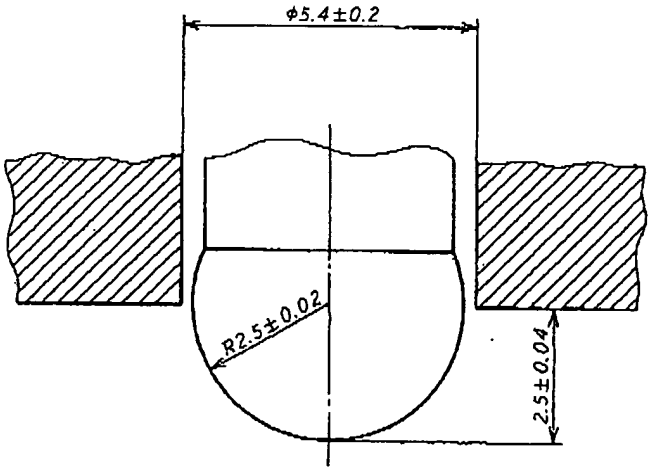


Fig. 3 Indentor for type E durometer

5.3.4 Scale When the scale indicates 0 (full protrusion), the point of the indentor shall protrude by (2.50 ±0.04) mm beyond the face of the pressure foot.

When the scale indicates 100 (nil protrusion), the face of the pressure foot is in firm contact with a flat piece of glass, i.e. the point of the indentor shall be positioned on the same plane with the face of the pressure foot. The scale shall be graduated with equal intervals in the range between 0 to 100.

5.3.5 Spring There must be the following relation between the force of spring and the scale, that is, the durometer hardness.

(1) **Type D durometer**

$$W_D = 444.5H_D \{w_D = 45.33H_D\}$$

where, W_D : force of spring of type D durometer (mN)

w_D : force of spring of type D durometer {gf}

H_D : hardness of type D durometer

(2) **Type A and type E durometer**

$$W_A = 550 + 75H_A \{w_A = 56.1 + 7.65H_A\}$$

where, W_A : force of spring of type A or type E durometer (mN)

w_A : force of spring of type A or type E durometer {gf}

H_A : hardness of type A or type E durometer

The tolerance of force shall be, in case of type D durometer, ±440 mN {±44.9 gf}, and in case of type A and type E durometer, ±80 mN {±8.16 gf}.

5.3.6 Calibration of spring Hold vertically the end point of indentor of a durometer on a balance not to give any interference between the balance and face of pressure foot, via a spacer (see Fig. 4). The cylindrical spacer with 2.5 mm height, in case of type D and type A durometer, measuring 1.25 mm in diameter, and in case of type E durometer, measuring 3 mm in diameter, has a wineglass shape where an indentor is to touch, in order to smoothly receive the end point of the indentor. Place a tare on the balance against the weight of the spacer. Place counterweight to get suitable scale, and confirm that the force (mN) shown here stays within the tolerance of specified force in **5.3.5**. Carry out the above calibration using suitable scale interval.

The calibration of spring of a durometer may be done with an electrobalance other than chemical balance shown in Fig. 4. In this case, the measuring sensitivity of the force at end point of an indentor shall be, in case of type D durometer, 44 mN {4.5 gf} or less, and in case of type A and type E durometer, 8 mN {0.82 gf} or less.

The following method is permissible; place upside down the durometer, and directly apply the load on its indentor by counterweight. Provided that the correction about the mass of parts inside of the durometer shall be considered to prevent the discrepancy between this method and the method by Fig. 4. In this case, the accuracy on the mass of counterweight shall be ±4.5 g or less in case of type D durometer and ±0.82 g or less in case of type A and type E durometer.

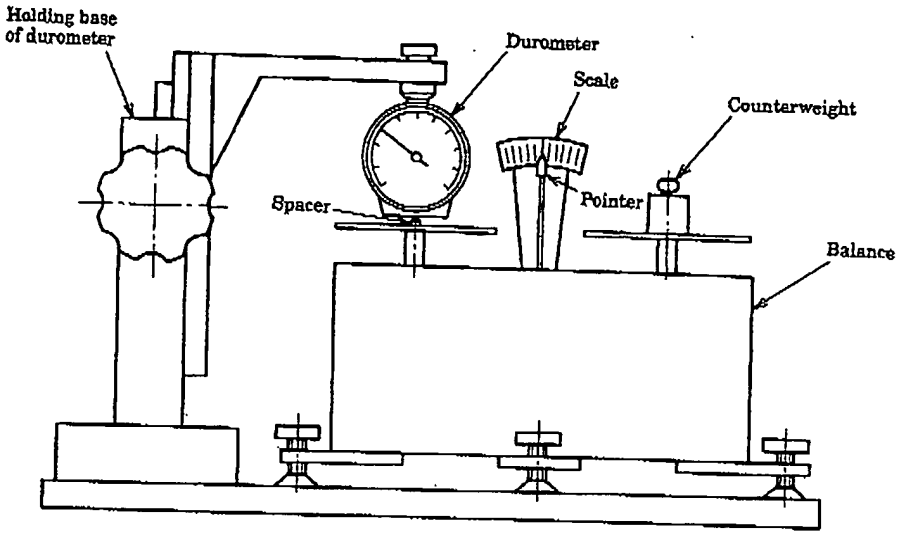


Fig. 4 Example of calibration apparatus of spring

5.4 Test piece

5.4.1 Shape and dimensions of test pieces The thickness of a test piece for type D and type A durometer is 6 mm or more. When it is less than 6 mm, pile them to make 6 mm or more for measurement. The thickness of a test piece for type E durometer is 10 mm or more, and in case of less than 10 mm, pile them to make 10 mm or more. The number of test pieces to pile shall be at most 3, and each of them shall have 2 mm or more thickness. The test result brought by piled up test piece doesn't generally coincide with the result by solid test piece(13). The lateral size of test piece shall be large enough to measure at the point where the end point of an indentor is apart 12 mm or more from the edge of the test piece.

Furthermore, the test piece shall have smooth surface spacious enough to make close contact with face of pressure foot of a durometer(14).

Notes (13) To make comparison, it is necessary to use the test piece which has the same number for piling and the same thickness.

(14) The surface such as unsmoothed, curved, or rough, does not give satisfactory results. For specially formed surface, however, such as rubber roll, this method can be applied. In this case, the applicable limit of the durometer shall be definitely confirmed.

5.4.2 Sampling and preparation of test pieces The sampling and preparation of test pieces shall follow **6.5** of **JIS K 6250**.

5.4.3 Selection of test pieces The test pieces which contain alien matters, bubbles, or flaws shall not be used for test.

5.5 Testing method

5.5.1 Testing conditions Testing conditions shall be as follows.

(1) The standard conditions of a laboratory shall follow **6.1** of **JIS K 6250**.

(2) Storing of sample and test pieces shall follow **6.2** of **JIS K 6250**.

(3) The standard conditions of test pieces shall follow **6.3** of **JIS K 6250**.

5.5.2 Procedures Place a test piece on a rigid, hard, and flat surface. Set a durometer so as to make an indentor rectangular to the target surface of a test piece. Contact closely as swiftly as possible the face of pressure foot with the target surface of the test piece without giving a impact, and read the scale within 1 s, to find the hardness of the test piece(15). But the agreement between the parties concerned with delivery may permit to read when a definite time passed after close contacting between them. The end point of the indentor of a durometer must be apart 12 mm or more from the edge of the test piece. Unless otherwise specified, the duration from close contacting to the finish of reading shall be recorded. The measuring points shall be 5, which are apart at least 6 mm each other, and carry out measurements 5 times on these points. When hardness shown by type A durometer is over A90, employ a type D durometer. When the hardness shown by type D durometer is less than D20, employ a type A durometer. If the hardness by type A durometer is less than A10, result is inaccurate, so don't record it.

When the hardness by a type A durometer is less A20, measure it with a type E durometer.

Note (15) In order to get a good repeatability, the holding base for durometer may be used by which the durometer is vertically kept and target surface and indentor get right angle each other before measurement. In this case, it is recommended that the mass imposed on the pressing surface is 5.0 kg for type D durometer, and 1.0 kg for both type A and type E durometer.

5.6 Arrangement of test results Round off the median of 5 measurements to whole number according to **JIS Z 8401**, and mark sign D in case of type D durometer, sign A in case of type A durometer, and sign E in case of type E durometer, just before the rounded value. When the value was read when definite time passed after close contacting, mark sign "/" and then record the duration (s). When it is standard hardness, the above is followed by "/" and then by sign S.

Example 1 D85/15/S: means that standard test piece is measured by type D durometer hardness test, and the reading on standard hardness is 85 when 15 s passed after close contacting of face of pressure foot.

Example 2 A45/S: means that standard test piece is measured by type A durometer hardness test, and the reading on standard hardness is 45 within 1 s after close contacting of face of pressure foot.

Example 3 A45/15: means that nonstandard test piece is measured by type A durometer hardness test, and the reading on apparent hardness is 45 when 15 s passed after close contacting of face of pressure foot.

Example 4 E60: means that nonstandard test piece is measured by type E durometer hardness test, and the reading on apparent hardness is 60 within 1 s after close contacting of face of pressure foot.

5.7 Record On test result, the following items shall be recorded.

(1) Test result

(2) Shape and dimensions of test piece (whether standard test piece or nonstandard test piece; in case of piled up test piece, the number of piled pieces, and its thickness)

(3) Sampling and preparation methods of test pieces

(4) Other items specially needed

6 IRHD pocket hardness test

6.1 Purpose This test shall be carried out to measure the international rubber hardness degree of vulcanized rubber by IRHD pocket hardness meter, and abbreviated P method.

6.2 Testing apparatus

6.2.1 Outline of testing apparatus The testing apparatus is composed of a face of pressure foot to press the surface of a test piece, indentor which protrudes from a central hole of face of pressure foot by action of a spring, and a mechanism indicating the protruded length of the indentor.

6.2.2 Face of pressure foot The face of pressure foot, measuring (20 ±2.5) mm sided square, has a hole with 2.0 mm to 3.0 mm diameter at its center.

6.2.3 Indentor The end of the indentor shall make a hemisphere with 1.55 mm to 1.60 mm diameter.

6.2.4 Indicating mechanism The indicating mechanism shows the protruded length of an indentor from face of pressure foot, and it shall have been calibrated to read directly the international rubber hardness degree by IRHD. When the longest protruded length of 1.65 mm is given, it must show 28 IRHD, and when the face of pressure foot is let contact with a flat glass, that is, no protruded, it must show 100 IRHD.

6.2.5 Spring Spring can apply constant force of (2.65 ±0.15) N {(270.3 ±15.3) gf} to an indentor in the range from 28 IRHD to 100 IRHD.

6.2.6 Calibration of hardness meter IRHD pocket hardness meter shall be calibrated and adjusted using a standard rubber block whose international rubber hardness degree has been known. Only when the standard rubber block cannot be used, it is preferably calibrated with mechanical method.

Press the IRHD pocket hardness meter on a flat glass plate, and adjust the scale to get 100 IRHD. Making use of a set of standard rubber blocks from 30 IRHD to 90 IRHD, calibrate IRHD pocket hardness meter. The set of standard rubber blocks is stored in a container with a suitable cover after being sprinkled with talc powder, in order to prevent the influences by light, heat, oil, or grease. It consists of at least 6 test pieces. These standard blocks must be calibrated with the international rubber hardness test specified in 4 at intervals not exceeding six months. It is advisable that the IRHD pocket hardness meter, which is used daily, is calibrated at least once a week with standard rubber block.

Remarks : When IRHD pocket hardness meter is calibrated with mechanical method or adjusted, the instruction manual issued by the manufacturer shall be depended.

6.3 Test piece

6.3.1 Shape and dimensions of test pieces The thickness of a test piece shall be 6 mm or more. When it is less than 6 mm, the test piece which was prepared by piling up to 6 mm or more can be used, but the number of piling up shall be 3 or less, and each of them shall have 2 mm or more thickness. The test result comes from piled test piece does not usually coincide with the test result by solid test piece(13). The lateral dimension of a test piece shall be large enough to measure at the point where the end point of an indentor is apart 12 mm or more from the edge of the test piece.

Test pieces shall have flat surface which is spacious to closely contact with the face of pressure foot of a hardness meter(16).

Note (16) The surface such as unsmoothed, curved, or rough, does not give satisfactory results. For specially formed surface, however, such as rubber roll, this method can be applied. In this case, the applicable limit of the IRHD pocket hardness meter shall be definitely confirmed.

6.3.2 Sampling and preparation of test pieces The sampling and preparation of test pieces shall follow **6.5** of **JIS K 6250**.

6.3.3 Selection of test pieces The test pieces which contain alien matters, bubbles, or flaws shall not be used for test.

6.4 Testing method

6.4.1 Testing conditions Testing conditions shall be as follows.

(1) The standard conditions of a laboratory shall follow **6.1** of **JIS K 6250**.

(2) Storing of sample and test pieces shall follow **6.2** of **JIS K 6250**.

(3) The standard conditions of test pieces shall follow **6.3** of **JIS K 6250**.

6.4.2 Procedures Place a test piece on a rigid, hard, and flat surface. Set an IRHD pocket hardness meter so as to make an indentor rectangular to the target surface of a test piece. Contact closely as swiftly as possible the face of pressure foot with the target surface of the test piece without giving a impact, and read the scale within 1 s, to find the hardness of the test piece. The end point of the indentor of an IRHD pocket hardness meter must be apart 12 mm or more from the edge of the test piece. Unless otherwise specified, read the value within 1 s after close contacting, but if the reading after special duration is specified, follow that specification. In this case, the duration from close contacting to the finish of reading shall be recorded. The measuring points shall be 5, which are apart at least 6 mm each other, and carry out measurements 5 times on these points.

6.5 Arrangement of test results Round off the median of 5 measurements to whole number according to **JIS Z 8401**, then mark sign IRHD after the value, and in case of standard hardness, after the value mark sign "/", then sign S, then again sign "/" and last sign P which means testing method. In case of apparent hardness, mark sign "/" after sign IRHD, then mark sign P which means testing method.

Example 1 50 IRHD/S/P: means that standard test piece is measured by IRHD pocket hardness meter, and the standard hardness is 50 IRHD.

Example 2 50 IRHD/P: means that nonstandard test piece is measured by IRHD pocket hardness meter, and the apparent hardness is 50 IRHD.

6.6 Record On test result, the following items shall be recorded.

(1) Test result

(2) Shape and dimensions of test piece (whether standard test piece or nonstandard test piece; in case of piled up test piece, the number of piled pieces, and its thickness)

(3) Sampling and preparation methods of test pieces

(4) Other items specially needed

Related standards :

ISO 7267/1 : 1986 *Rubber-covered rollers—Determination of apparent hardness—Part 1 : IRHD method*

ISO 7267/2 : 1986 *Rubber-covered rollers—Determination of apparent hardness—Part 2 : Shore-type durometer method*

Informative reference
International rubber hardness testing method for curved test piece

Introduction This Informative reference states the international rubber hardness testing method for curved test piece, and does not make a part of Standard.

1 **Purpose** This test shall be carried out to measure international rubber hardness degree of a test piece of vulcanized rubber whose target surface makes a curved surface. The measured values obtained by this method are always treated as an apparent hardness.

Remarks : The standards cited in this Informative reference are listed as follows.

ISO 48 : 1994 *Rubber, vulcanized or thermoplastic—Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 7267/1 : 1986 *Rubber-covered rollers—Determination of apparent hardness—Part 1 : IRHD method*

ISO 7267/2 : 1986 *Rubber-covered rollers—Determination of apparent hardness—Part 2 : Shore-type durometer method*

2 **Type of testing method**

(1) CH method (normal size curved surface test for high hardness)

(2) CN method (normal size curved surface test for normal hardness)

(3) CM method (microsize curved surface test for normal hardness)

(4) CL method (normal size curved surface test for low hardness)

3 **Scope** CH method, CN method, CM method, and CL method are the modified H method, N method, M method, and L method for the purpose of making them applicable to the test piece whose target surface is curved, and there are the following two cases(1).

(1) Test piece or sample is large enough to place the hardness testing apparatus on it.

(2) Test piece or sample is so small that it must be placed on a holding base together with a hardness testing apparatus. The case where the sample is put on a flat sample base which makes one body with a testing apparatus, is included in this case.

Note (1) Generally, these tests are carried out directly on products, so that the thickness of rubber is not constant, and in many cases, the lateral distance from the end ball of a plunger to the edge of sample is smaller than the smallest distance shown in **4.4.3** in the body of this Standard, and the influence owing to the distance from the edge is not negligible.

Therefore, the measured values resulted from these methods don't coincide with the values obtained by the measurements of the plate-type test pieces with flat parallel surfaces and the same thickness as that of standard test pieces or products which are specified in H method, N method, M method and L method.

This means that, the results obtained by measuring curved surface are the peculiar measurements which are applicable only to the test pieces or the products having special shape and special dimensions and further being kept in special method. In extreme case, these measured values show discrepancy of 10 IRHD from the standard hardness. The measured values on the surface buffed to eliminate covered cloth or treated specially, shows a little difference value from the value on flat surface which has been finished with molding.

4 Testing apparatus

4.1 General matters Basically, testing apparatus follows **4.3** of the body of this Standard, but the following gives difference.

4.2 Testing apparatus for cylindrical surface of 50 mm or more radius As shown in Informative reference Fig. 1, the bottom base of the testing apparatus has a hole through which annular pressure foot can penetrate, for the measurement even when sample is put under the base.

There are two cylindrical surfaces which are parallel each other under the base, and these are parallel to the horizontal surface of the base. The diameter of these cylinders and the distance between them shall be suitable for setting up testing apparatus on the target curved surface of sample. Alternatively, the base, on which adjustable legs with universal joints are attached to comply with the target curved surface, may be used.

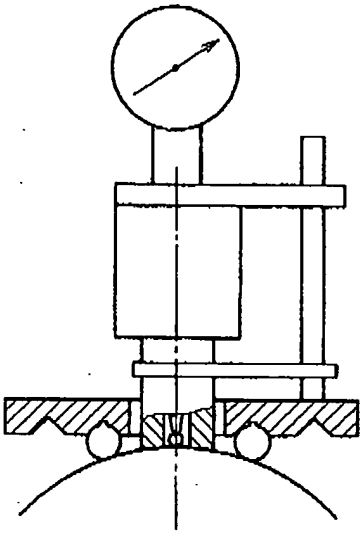
4.3 Testing apparatus for two-way curved surface of 50 mm or more radius The testing apparatus with adjustable legs with universal joints shown in **4.2** can be used.

4.4 Testing apparatus for cylindrical surface and two-way curved surface of 4 mm to 50 mm radius When target surface is too small to set a testing apparatus on it, as shown in Informative reference Fig. 2, fix test piece or sample using a special jig, V-block, or the like, and set the plunger to be perpendicular onto the target surface. When a small test piece is fixed on a sample table, wax may be used(²)(³).

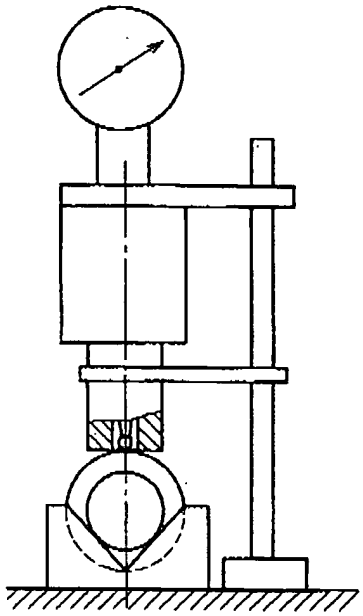
Notes (²) The testing apparatus for M method shall be generally used only for the test piece whose thickness is 4 mm or less.

(³) The testing apparatus for M method, whose sample table is forced up owing to the action of a spring, is not suitable for the large-sized test piece or sample having curved surface with large radius.

4.5 Testing apparatus for small type O-ring and curved sample of 4 mm or less radius In these cases, hold a test piece on the table of testing apparatus using a suitable jig, block, wax, or the like. Carry out measurement using a testing apparatus of M method. The test piece having the minimum radius of 0.8 mm or less cannot be measured.



Informative reference Fig. 1
Example of setting a testing apparatus for sample with large diameter



Informative reference Fig. 2
Example of setting a testing apparatus for sample with small diameter

5 Test pieces

5.1 General matters The test pieces for CH method, CN method, CM method, and CL method are the products or the pieces prepared by cutting the products. The bottom side of the test piece which has been cut out shall be held with suitable method. In case of the target surface is covered with cloth, it must be buffed before testing. In order to recover it from the influence by buffing, allow it to stand for 16 h or more under standard condition of laboratory, and then carry out conditioning under standard condition according to (3) of 4.5.1 in the body of this Standard. This duration may be included in the duration for recovering.

5.2 Sampling and preparation of test pieces The sampling and preparation of test pieces shall follow 4.4.4 in the body of this Standard.

5.3 Selection of test pieces The selection of test pieces shall follow 4.4.5 in the body of this Standard.

6 Testing method The testing method shall follow 4.5 in the body of this Standard.

7 Arrangement of test results Round off the median of 3 or 5 measurements to whole number according to **JIS Z 8401**, and then mark sign IRHD after the value. After that, mark sign "/", and then mark CH, CN, CM, or CL which means testing method.

Example : 50 IRHD/CM: means that a curved test piece is measured by CM method of international rubber hardness curved-surface test, and the hardness is 50 IRHD.

8 Record On test result, the following items shall be recorded.

(1) Test result

(2) Shape and dimensions of test pieces

(3) Sampling and preparation methods of test piece

(4) Test temperature

(5) Other items specially needed

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